

Texas Administrative Code (TAC), Title 19, Part II - Chapter 112. Texas Essential Knowledge and Skills for Science	
Standard	Data Source and/or Resource
112.36. Earth and Space Science, Beginning with School Year 2010-2011 (One Credit).	
(A) Systems. A system is a collection of interacting physical, chemical, and biological processes that involves the flow of matter and energy on different temporal and spatial scales. Earth's system is composed of interdependent and interacting subsystems of the geosphere, hydrosphere, atmosphere, cryosphere, and biosphere within a larger planetary and stellar system. Change and constancy occur in Earth's system and can be observed, measured as patterns and cycles, and described or presented in models used to predict how Earth's system changes over time.	<p>Biological System Modeling: SimLab http://www.ucopenaccess.org/course/view.php?id=13 This simulation models the response of hypothetical organisms to stress due to high temperatures.</p> <p>Objectives</p> <ul style="list-style-type: none"> • Understand that natural selection works because well adapted organisms have more offspring. • Changes in the characteristics of organisms occur from one generation to the next, not because organisms change during their lifetimes. • A population of organisms cannot adapt to changes that are too large or rapid. • Natural selection optimizes the population of organisms to the local conditions.
(C) Relevance. The interacting components of Earth's system change by both natural and human-influenced processes. Natural processes include hazards such as flooding, earthquakes, volcanoes, hurricanes, meteorite impacts, and climate change. Some human-influenced processes such as pollution and unsustainable use of Earth's natural resources may damage Earth's system. Examples include <u>climate change</u> , soil erosion, air and water pollution, and biodiversity loss. The time scale of these changes and their impact on human society must be understood to make wise decisions concerning the use of the land, water, air, and natural resources. Proper stewardship of Earth will prevent unnecessary degradation and destruction of Earth's subsystems and diminish detrimental impacts to individuals and society.	<p>Measuring Climate: SimLab http://www.ucopenaccess.org/course/view.php?id=13 OBJECTIVES:</p> <ul style="list-style-type: none"> • Learn that climate is the long term average of weather at a given location • Local climates can be classified into different general categories • Measurements are subject to uncertainties <p>Traditional Lab: Soil Type Activity http://www.ucopenaccess.org/courses/APEnvSciv2/course%20files/assignments/chapter11extralab1.html In this activity you will collect a local soil sample and use a simple procedure to determine what type of soil is present.</p>
(E) demonstrate the use of course equipment, techniques, and procedures, including computers and web-based computer applications;	My NASA Data Live Access Server: Advanced http://mynasadata.larc.nasa.gov/las72/getUI.do
(F) use a wide variety of additional course apparatuses, equipment, techniques, and procedures as appropriate such as satellite imagery and other remote sensing data, Geographic Information Systems (GIS), Global Positioning System (GPS), scientific probes, microscopes, telescopes, modern video and image libraries, weather stations, fossil and rock kits, bar magnets, coiled springs, wave simulators, tectonic plate models, and planetary globes;	<p>Interactive Maps of TWDB: Daily Water Levels - Using Google Earth Tools. For a list of all TWDB and cooperator recorder sites, with hydrographs and raw data, click here.</p> <p>To save a copy of TWDB and cooperator well recorder sites to your computer, you must first download and install the free program Google Earth. Once Google Earth is installed, click the TWDB file and Google Earth will open with the recorder well sites shown. To view the water level hydrograph and all water level data click on any well site. Make sure to save the file to "My Places" so you can view the map when you open Google Earth again.</p> <p>You may also use the embedded Virtual Earth map below to view TWDB and cooperator well recorder sites. To view the water level hydrograph and all water level data click on any well site.</p> <p>http://www.twdb.state.tx.us/gwrd/waterlevels/waterlevels.html</p> <p>Maps: TWDB's most commonly requested maps are available for download, in both Adobe PDF and JPG formats. http://www.twdb.state.tx.us/mapping/maps.asp</p> <p>Earth Observatory: Weighing Earth's Water from Space http://earthobservatory.nasa.gov/Features/WeighingWater/</p>
(G) organize, analyze, evaluate, make inferences, and predict trends from data;	Addressed by PBL task

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(H) use mathematical procedures such as algebra, statistics, scientific notation, and significant figures to analyze data using the International System (SI) units; and	Crop Moisture Index (CMI), Palmer Drought Severity Index (PDSI), Standardized Precipitation Index (SPI), Keetch-Byram Drought Index (KBDI), Reservoir Storage (RS), Streamflow Index (SFI). http://www.twdb.state.tx.us/apps/droughtinfo/default.aspx
(I) communicate valid conclusions supported by data using several formats such as technical reports, lab reports, labeled drawings, graphic organizers, journals, presentations, and technical posters.	Addressed by PBL task
(J) perform calculations using dimensional analysis, significant digits, and scientific notation; and	Addressed by PBL task
(K) communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.	Addressed by PBL task
(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:	
(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;	Addressed by PBL task
(F) learn and understand the contributions of scientists to the historical development of Earth and space sciences.	San Antonio Missions: Spanish Influence in Texas http://www.nps.gov/nr/twhp/wwwlps/lessons/2sanantonio/2sanantonio.htm
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(5) Science concepts. The student knows the interrelationships among the resources within the local environmental system. The student is expected to:	
(A) summarize methods of land use and management and describe its effects on land fertility;	NASA GSFC Land Information System - A modeling system to support problem-solving and decision support systems for land and water management: http://lis.gsfc.nasa.gov/LIS_whatIs.php
(B) identify source, use, quality, management, and conservation of water;	Water Reuse and Innovative Water Technologies http://www.twdb.state.tx.us/innovativewater/reuse/
(C) document the use and conservation of both renewable and non-renewable resources as they pertain to sustainability;	SimLab: Natural Resources: Water http://www.ucopenaccess.org/course/view.php?id=13 OBJECTIVES: <ul style="list-style-type: none"> • Understand the concepts of sustainability and carrying capacity • Variations in the environment cause variations in carrying capacity Data: Texas Water Development Board Drought Information Summary http://www.twdb.state.tx.us/apps/droughtinfo/default.aspx
(E) analyze and evaluate the economic significance and interdependence of resources within the environmental system; and	Environment & Society: Economic Forces: SimLab http://www.ucopenaccess.org/course/view.php?id=13 OBJECTIVES: <ul style="list-style-type: none"> • Understand the basic concept of supply and demand, as well as how the market price is set. • Understand the effects of taxation due to environmental concerns and the effects of conservation on market price.
(F) evaluate the impact of waste management methods such as reduction, reuse, recycling, and composting on resource availability.	Addressed by PBL task
(6) Science concepts. The student knows the sources and flow of energy through an environmental system. The student is expected to:	
(A) define and identify the components of the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere and the interactions among them;	Hydrographic Survey: Measuring and mapping the surface waters of Texas - Reservoir Terminology http://midgewater.twdb.state.tx.us/swrweb/swr/hydro/Hydro_Definitions.html#con_storagePool

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(7) Science concepts. The student knows the relationship between carrying capacity and changes in populations and ecosystems. The student is expected to:	
(A) relate carrying capacity to population dynamics;	Population SimLab http://www.ucopenaccess.org/course/view.php?id=13
(D) analyze and make predictions about the impact on populations of geographic locales due to diseases, birth and death rates, urbanization, and natural events such as migration and seasonal changes.	BioDiversity Lab: http://www.ucopenaccess.org/course/view.php?id=13 ASSUMPTIONS: <ul style="list-style-type: none"> • No animals can leave or enter the simulation system. • No females are pregnant initially. INPUT VARIABLES: <ul style="list-style-type: none"> • Time Limit: The number of time steps to run the simulation. • Loss Factor: The fraction of habitat that will be lost. A loss factor of 0.0 means no habitat is lost while a loss factor of 1.0 means the entire habitat is lost. • Loss Time: The number of time steps for the habitat loss to occur. OBJECTIVES: <ul style="list-style-type: none"> • Observe how a minimum amount of habitat is needed to sustain animals in that area. • Understand that animals can become extinct in small isolated habitats. More at: University of Wisconsin, Dept of Natural & Applied Sciences http://www.uwgb.edu/nas/resources.htm
AP - (7) Earth in space and time. The student knows that scientific dating methods of fossils and rock sequences are used to construct a chronology of Earth's history expressed in the geologic time scale. The student is expected to:	CEOS Climate Diagnostics: http://idn.ceos.org
(D) interpret Earth surface features using a variety of methods such as satellite imagery, aerial photography, and topographic and geologic maps using appropriate technologies; and	Global Change Master Directory: Discover Earth Science data and services: http://gcmd.nasa.gov Drought Map Comparisons (Weekly data updates) Texas Water Development Board: Drought Information Summary http://www.twdb.state.tx.us/apps/droughtinfo/AllMapView.aspx Diamond-O Ranch Vegetation and Climate Abstract: The intent of the Diamond-O Ranch Vegetation and Climate data set, which describes Starr County, Texas, is to determine what variations exist in different rangeland vegetation communities for temperature and relative humidity in the soil/vegetation interface. Data were collected using a wing thermistor and Vaisala relative humidity sensors, through Campbell Scientific data loggers. Relative humidity probes were calibrated using saturated salt solutions. http://gcmd.nasa.gov/KeywordSearch/Metadata.do?Portal=GCMD&KeywordPath=Locations [Fretext%3D%27+Texas%27]&OrigMetadataNode=GCMD&EntryId=MSU0002&MetadataView=Full&MetadataType=0&lbnode=mdl3
(E) evaluate the impact of changes in Earth's subsystems on humans such as earthquakes, tsunamis, volcanic eruptions, hurricanes, flooding, and storm surges and the impact of humans on Earth's subsystems such as population growth, fossil fuel burning, and use of fresh water.	Earth Observatory Lesson: Drought: The Creeping Disaster http://earthobservatory.nasa.gov/Features/DroughtFacts/drought_facts.php

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(C) discriminate between renewable and nonrenewable resources based upon rate of formation and use;	AP Environmental Science Virtual Labs - Unit 1: Earth's Systems Flow of Energy (at the household level) - description Simulation Lab - run lab http://www.ucopenaccess.org/course/view.php?id=13 OBJECTIVES: <ul style="list-style-type: none"> • To analyze energy-consumption data for renewable energy sources (e.g., hydro power and non-renewable energy sources, such as gasoline). • Conversion of energy to different forms. • Manage an energy system to minimize non-renewable energy consumption.
(13) Fluid Earth. The student knows that the fluid Earth is composed of the hydrosphere, cryosphere, and atmosphere subsystems that interact on various time scales with the biosphere and geosphere. The student is expected to:	Traditional Lab: Chapter 5: The Biosphere Species Diversity Activity Using Simpson's Index http://www.ucopenaccess.org/courses/APEnvSciv2/course%20files/assignments/chapter15extralab1.html
(A) quantify the components and fluxes within the hydrosphere such as changes in polar ice caps and glaciers, salt water incursions, and groundwater levels in response to precipitation events or excessive pumping;	Animation of Streamflow maps: http://waterwatch.usgs.gov/new/index.php?id=ww_animation_real
(B) analyze how global ocean circulation is the result of wind, tides, the Coriolis effect, water density differences, and the shape of the ocean basins;	Addressed in activity: Investigating Factors that Influence Climate - employs inquiry methods to investigate how latitude and longitude (and distance from oceans) impact climatic factors such as temperature range, average temperature, and precipitation.
(C) analyze the empirical relationship between the emissions of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature trends over the past 150 years;	Addressed in activity: Investigating Factors that Influence Climate - employs inquiry methods to investigate how latitude and longitude (and distance from oceans) impact climatic factors such as temperature range, average temperature, and precipitation.
(D) discuss mechanisms and causes such as selective absorbers, major volcanic eruptions, solar luminance, giant meteorite impacts, and human activities that result in significant changes in Earth's climate;	Global Warming Sim Lab http://www.ucopenaccess.org/course/view.php?id=1 ASSUMPTIONS: <ul style="list-style-type: none"> • The Earth's surface and atmosphere are uniform. INPUT VARIABLES: <ul style="list-style-type: none"> • Greenhouse Forcing: This controls the trapping of long wavelength (heat) radiation by the atmosphere. It is zero if the trapping of long wavelength radiation is near the present day value (this doesn't mean no trapping - if there were no trapping of long wavelength radiation the Earth would be much colder than it is now). If this is greater than zero the amount of trapping is increased. • Rise time: The amount of time in years that it takes for the greenhouse forcing to rise from zero to the value specified by the "Greenhouse Forcing" parameter. A rise time of 0 will cause the greenhouse forcing to begin immediately. • Feedback: This controls the feedback due to warming induced changes in the Earth. A positive value indicates positive feedback, while a negative value indicates negative feedback. OBJECTIVES: <ul style="list-style-type: none"> • Understand the importance of feedback for determining the severity of global warming. • Observe that the response to greenhouse forcing can take many years.